Biological Forum – An International Journal **15(9): 1041-1045(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of different Dates of Sowing, Irrigation Scheduling and Soil Amendments on Yield Attributes and Yield of Wheat

CH V L Kishore*, Sharad Pandey, Maneesh Bhatt, Mamta and BKM Patro
Department of Agriculture, School of Agriculture,
Forestry and Fisheries, Himgiri Zee University, Chakrata Road, Dehradun (Uttarakhand), India.

(Corresponding author: CH V L Kishore)*
(Received: 05 July 2023; Revised: 08 August 2023; Accepted: 09 September 2023; Published: 15 September 2023)
(Published by Research Trend)

ABSTRACT: A two-year field experiments were conducted during the *rabi* season of 2020–21 and 2021–22 at the Agriculture Farm, Himgiri Zee University, P.O. Sherpur, Chakrata Rd. Dehradun, Uttarakhand, to study theeffect of different dates of sowing, irrigation scheduling, and soil amendments on the yield attributes and yield of wheat (*Triticum aestivum* L.). The study consists of three irrigation schedulings: *viz.*, I_1 (irrigation at 40% depletion from ASM), I_2 (irrigation at 50% depletion from ASM), and I_3 (irrigation at growth stages) in the main plots, while the three soil amendments S_1 (FYM @ 10 t ha^{-1}), S_2 (urban compost @ 5 t ha^{-1}), and S_3 (vermicompost @ 5 t ha^{-1}) are in the sub-plots with two dates of sowing, *viz.*, D_1 (timely sown) and D_2 (late sown) in the sub-sub plot with three replications. Among the different dates of sowing, irrigation scheduling and soil amendment application, of D_1(timely sown), I_1 (irrigation at 40% depletion from ASM), and S_3 (vermicompost @ 5 t ha^{-1}) showed the maximum yield attributes of wheat *viz* spike weight, number of spikelets per spike, number of grains per spike and test weight were observed during both years of the experiment (2020-21 and 2021-22), respectively.

Timely sowing of wheat crop I_1 (irrigation at 40% depletion from ASM), and S_3 (vermicompost @ 5 t ha^{-1}) showed the maximum yield observation, *viz.*, grain yield, biological yield, and harvest index were observed during both years of the experiment (2020-21 and 2021-22), respectively. Thus, it can be concluded that a timely sown wheat crop, along with 40% depletion of available soil moisture and vermicompost @ 5 t ha^{-1} showed the best agronomic practices and resulted in the highest grain yield and economic return under sandy loam soil conditions at Himgiri Zee University.

Keywords: Different dates of sowing, irrigation scheduling, and soil amendments.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important crop among all cereals used as food grains in the world. It provides nearly 55% of the carbohydrate and 20% of the calories, which are consumed by two billion people (36% of the world population) as staple foods. It is more nutritious as compared to other cereals. It has a good nutrition profile with an average of 12.2% protein, 1.8% lipids, 1.8% ash, and 2.0% reducing sugars, and it also provides 314 kcal per 100 g of food. It ranks first in the world for cereal area and production. In the marketing year 2022–23, the global production volume of wheat amounted to over 781 million metric tons. This was an increase as compared to the previous marketing year. In India, wheat acreage was 34.1 million hectares, up from 34 million hectares the previous year (Ministry of Agriculture). "The output is likely to increase, but not too much, as the sown area under wheat was largely steady", a trader in Delhi said. India's wheat production during the years 2022–23 has been estimated at a record high of 112.18 million metric tons (mt), 4 percent higher than 107.74 mt last crop year (Ministry of Agriculture). In the financial year 2022, India's production volume of wheat during the *rabi* season was estimated to be over 106 million metric tons. Wheat production across the South Asian countries has reflected steady growth over the years. Wheat is the second-most common food crop grown globally. India's 2023 wheat production is likely to rise 4.1% to a record 112.2 million metric tons, as higher prices prompted farmers to expand crop-growing areas with high-yielding varieties and the weather remained favorable. India's wheat output fell to 107.74 million metric tons in 2022 from 109.59 million metric tons a year earlier, according to the Ministry of Agriculture and Farmers Welfare. In Uttarakhand, the productivity of wheat was reported at 3.07 t/ha during the years 2021–22. In the financial year 2021, about 955 thousand metric tons of wheat were produced in the northern state of Uttarakhand in India. This was an increase from a production volume of over 600,000 metric tons in year 2015. The largest cultivable area in Uttarakhand is covered by the wheat crop, followed by the paddy crop. The net cultivable area in Uttarakhand is about 358.1 hectares, with a production of 858.2 tons. Uttarakhand consists of hilly tracts as well as tarai areas where wheat is an important crop during *rabi*. It has a contribution of 1.51% towards national production from 1.07% of the wheat-growing area of the country, with a productivity of 1.9 tons/ha. This is due to the fact that wheat in the hills is mainly rainfed as compared to irrigated crops in the tarai. The total area under wheat is

0.4 million ha, with a total production of 0.8 tons and productivity of 1.9 tons/ha over the last five years. The constraints are water scarcity in hills and *Tarai* areas, low soil organic carbon status, high nutrient mining, imbalanced fertilization, and infestations of powdery mildew and Karnal bunt diseases. There are many factors responsible for the low yield of the wheat crop, but inadequate irrigation and poor crop nutrition are the most important. Therefore, irrigation scheduling is one of the most important professional activities, and it aids in the efficient consumption of water by crops. It governs the process of deciding when to irrigate, how to irrigate, and how much water to apply to the crop. It optimizes agricultural production by minimizing yield loss due to water shortages and improving the performance and sustainability of any irrigation system by conserving water. Timely sowing of wheat crops has a longer growth duration, which consequently provides an opportunity to accumulate more biomass as compared to late sowing and hence manifests in higher grain and biological yield. Whereas in the case of delayed sowing, the wheat crop is exposed to sub-optimal temperatures at establishment and supra-optimal temperatures at reproductive phases, which leads to forced maturity and a reduction in grain yield. In India, the imbalanced use of chemical fertilizers by farmers has deteriorated soil health. Hence, there is a need to adopt the concept of integrated nutrient management, through which we may increase the productivity of the crop while also improving soil quality.

MATERIALS AND METHODS

A. Site of the experiment

The field experiments were conducted at the experimental farm of Himgiri Zee University, Dehradun, Uttarakhand, during the *rabi* season of 2020–2021 and 2021–2022.

B. Location

The experimental farm is situated at 30°19'N latitude, 78°04' longitude, and 650 meters above mean sea level.

C. Climate and Weather Conditions

The climate of Dehradun is moderate due to its location at the foot of the Himalayas. The climate of Dehradun is the same as any of the North Indian climates, *i.e.*, cool winters, warm summers, and rainy monsoons. During the summer, the maximum temperature is 360 °C and the minimum is 160 °C. In winter, the maximum temperature is 230 °C and the minimum is 50 °C. Dehradun gets an average rainfall of 2073.3 mm annually. Dehradun receives rainfall between June and September, though in December and January it receives winter rainfall through western disturbances.

D. Treatment and Design of the Experiment

Field experiments were laid out in a split-split plot design consisting of irrigation scheduling under the main plot (I_1= irrigation applied at 40 DASM; I_2= irrigation applied at 50 DASM; I_3= irrigation applied at critical plant growth stages); soil amendment under the sub-plot (S_1= FYM @ 10t ha^{-1}; S_2=urban compost@ 5 t ha^{-1}; S_3= vermicompost @ 5 t ha^{-1}); and date of sowing under the sub-subplot (D_1= timely sowing; D_2=late sowing) with a total of 18 treatments with three replications.

RESULTS AND DISCUSSION

Yield attributes. Among different dates of sowing, timely to sowing of wheat recorded the highest yield attributes, *viz.,* Spike weight (4.26g and 4.27g), number of spike lets per spike (7.23g and 7.21g), number of grains per spike (50.62g and 50.58g) and test weight (47.70g and 49.56g), yield observation *viz.*, grain yield (44.3 q ha^{-1} and 43.0 q ha^{-1}), biological yield (121.6 q + ha^{-1} and 122.3 q ha^{-1}), harvest index (36.4 and 35.2) during the years 2020-21 and 2021-22, respectively, where as in case of irrigation scheduling, (I_1)irrigation at 40% DASM recorded the significant maximum value of yield attributes *viz.*, spike weight (4.05g and 3.98g), number of spikelets per spike (6.24g and 6.23g), number of grains per spike (49.72g and 49.58g) and test weight (48.25g and 49.22g), yield observation *viz.*grain yield (43.8 q ha^{-1} and 42.7 q ha^{-1}), biological yield (120.1 q ha^{-1} and 120.8 q ha^{-1}) and harvest index (36.4 and 35.3) under different dates of sowing, irrigation scheduling and soil amendments during the year 2020-21 and 2021-22, respectively. However, among different soil amendments, application of vermicompost @ 5t ha^{1} recorded significantly maximum yield attributes, *viz.*, spike weight (4.06g and 4.08g), number of spikelets per spike (6.16 and 6.12), number of grains per spike (49.43 and 49.40) and test weight (48.03 and 48.03), yield observation, *viz.*, grain yield (43.3 q ha^{-1} and 42.5 q ha^{-1}), biological yield (119.8 q ha^{-1} and 120.5 q ha^{-1}), and harvest index (36.2 and 35.3), during the years 2020-21 and 2021-22, respectively.

The timely sown crop provides a favorable environment for the growth and development of the wheat crop. These findings were in agreement with Poudel *et al.* (2020)**.** Irrigation applied at 40 percent DASM provides optimum soil moisture conditions for a longer interval, which supports the growth and development of the wheat crop as compared with the other irrigation scheduling. These results were in line with the findings of Agami *et al.* (2018). The maximum spike weight in vermicompost-treated fields might be due to the higher uptake of nutrients in the treatment where vermicompost was applied, since vermicompost contains a high amount of NPK content as compared with other soil amendments. Similar results were reported by Cheraghi *et al.* (2016).

The increase in the number of spikelets per spike under timely sown might be due to better utilization of natural resources under favorable climatic conditions. These findings were in agreement with Poudel *et al.* (2020)**.** Irrigation applied at 40% DASM provides optimum soil moisture conditions for the wheat crop to uptake nutrients and thus increase its number of spikelets per spike. These results were in line with the findings of

Rady *et al.* (2021). The increase in the number of spikelets per spike might be due to the addition of a sufficient amount of nitrogen by the vermicompost, as it is a good source of NPK as compared with other soil amendments. These results were in consonance with the findings of Nishant *et al.* (2020).

The timely sown crop provides sufficient time during the vegetative and reproductive stages of the wheat crop to grow in a better way. These findings were in agreement with Muhsin *et al.* (2020). The highest grain per spike at 40% DASM might be due to the maximum uptake of water and nutrients for various metabolic activities, thereby increasing the number of grains per spike. These results were in line with the findings of Rady *et al.* (2021). The increase in the number of grains per spike might be due to the highest fertilizer use efficiency in the vermicompost-treated plot. These results were in consonance with the findings of Nishant *et al.* (2020).

Table 1: Effect of Dates of sowing, Irrigation scheduling and Soil amendments on number of grains Spike^{-1}, Test weight (g), Spikelet per spike and Spike weight (g) of wheat during *rabi* 2020-21 & 2021-22.

Sr. No.	Treatment details	No. of grains Spike^{-1}		Test weight (g)		Spike let per spike		Spike weight(g)	
		2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
A.	**Sowing Time**								
D_1	timely sowing	50.62	50.58	47.70	49.56	7.23	7.21	4.26	4.27
D_2	Late sowing	46.45	46.42	44.31	44.28	4.22	4.20	3.43	3.41
	S.E. ±	1.22	1.29	1.20	1.30	0.16	0.15	0.10	0.10
	CD at 5 %	7.47	7.89	3.42	4.11	1.00	0.98	0.67	0.64
B.	**Irrigation Scheduling**								
I_1	Irrigation at 40% depletion from ASM	49.72	49.58	48.25	49.22	6.24	6.23	4.05	3.98
I_2	Irrigation at 50% depletion from ASM	47.05	48.02	45.52	46.49	5.67	5.61	3.83	3.85
I_3	Irrigation at growth stages	46.94	47.89	45.09	46.05	5.26	5.27	3.67	3.69
	S.E. ±	1.30	1.39	1.24	1.38	0.17	0.17	0.10	0.10
	CD at 5 %	2.26	2.55	3.78	2.92	0.55	0.55	0.32	0.34
C.	**Soil Amendments**								
S_1	FYM @10 t ha^{-1}	48.97	48.95	47.52	47.51	6.02	5.99	3.91	3.92
S_2	Urban compost @5 t ha^{-1}	46.21	46.15	45.11	44.22	4.99	4.97	3.57	3.52
S_3	Vermicompost @5 t ha^{-1}	49.43	49.40	48.03	48.03	6.16	6.12	4.06	4.08
	S.E. ±	1.18	1.16	1.05	1.19	0.14	0.14	0.08	0.09
	CD at 5 %	2.44	2.39	3.08	3.11	0.42	0.41	0.26	0.27
D.	**Interaction**								
I.	D × I								
	CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
II.	I×S								
	CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
III.	S × D								
	CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
IV	D × I × S								
	CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS

Muhsin *et al.* (2020) opined that a maximum test weight of 34.18 g was recorded with the crop sown on December 15th. While the minimum test weight of 31.96 g was recorded with the crop sown on December 30th, The irrigation applied at 40% DASM provides sufficient moisture to the crop during the grain filling stages, thus increasing the test weight of the crop, while applying water stress conditions at these stages might reduce the grain formation, quality, and productivity of the wheat crop. Similar findings were reported by Badawy *et al.* (2021). The increase in test weight was directly related to the number of uptakes of ions. Therefore, in the vermicompost test, the weight was highest due to the maximum addition of nutrients to the soil. Similar results were also reported by Khan *et al.* (2018); Ali *et al.* (2020).

Shah *et al.* (2020) opined that a maximum grain yield of 6.4 t ha^{-1} was recorded with wheat crop sown on October 22, which was followed by crop sown on October 29 with a grain yield of 6.1 t ha^{-1}. The maximum grain yield in a vermicompost-treated plot may be due to the availability of more nutrients, which might have increased nutrient uptake and better translocation of nutrients. These results were in line with the findings of Yadav *et al.* (2018); Singh *et al.* (2018); Nishant *et al.* (2020).

During both years, the crop that was sown on time (D1) recorded significantly higher biological yields of 121.6 t ha1 and 122.3 t ha^{-1}. The maximum biological yield of

120.1 t ha^{-1} and 120.8 t ha^{-1} was recorded with the application of 40 percent DASM (I1), followed by I2 (50 percent DASM) available soil moisture with biological yields of 117.6 t ha^{-1} and 118.3 t ha^{-1}. The highest biological yield was shown where vermicompost was applied; this may be due to the greater availability of nutrients, which causes the highest uptake of nutrients and their translocation. Similar results were also reported by Nishant *et al.* (2020); Singh *et al.* (2018); Jat *et al.* (2018).

During both years, the crop that was sown early (D1) recorded significantly higher harvest indexes of 36.4 and 35.2. The maximum harvest index of 36.4 and 35.3 was recorded with the application of 40 percent DASM (available soil moisture) (I1), which was followed by I2 (50 percent DASM) (available soil moisture) with harvest indexes of 35.7 and 34.8. The maximum harvest index of 36.2 and 35.3 was recorded with S3 (vermicompost at 5 t ha^{-1}), which was followed by 36.1 and 34.9 with S1 (FYM at 10 t ha^{-1}). Similar results were also reported by Muhsin *et al.* (2020); Khan *et al.* (2018).

Table 2: Effect of Dates of sowing, Irrigation scheduling and Soil amendments Grain Yield (q ha^{-1}), Biological Yield (q ha^{-1}) and Harvest Index of wheat during *rabi* 2020-21 & 2021-22.

Sr. No.	Treatment details	Grain Yield (q ha^{-1})		Biological Yield (q ha^{-1})		Harvest Index	
		2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
A.	**Sowing Time**						
D_1	timely sowing	50.62	50.58	47.70	49.56	7.23	7.21
D_2	Late sowing	46.45	46.42	44.31	44.28	4.22	4.20
	S.E. ±	1.22	1.29	1.20	1.30	0.16	0.15
	CD at 5 %	7.47	7.89	3.42	4.11	1.00	0.98
B.	**Irrigation Scheduling**						
I_1	Irrigation at 40% depletion from ASM	49.72	49.58	48.25	49.22	6.24	6.23
I_2	Irrigation at 50% depletion from ASM	47.05	48.02	45.52	46.49	5.67	5.61
I_3	Irrigation at growth stages	46.94	47.89	45.09	46.05	5.26	5.27
	S.E. ±	1.30	1.39	1.24	1.38	0.17	0.17
	CD at 5 %	2.26	2.55	3.78	2.92	0.55	0.55
C.	**Soil Amendments**						
S_1	FYM @10 t ha^{-1}	48.97	48.95	47.52	47.51	6.02	5.99
S_2	Urban compost @5 t ha^{-1}	46.21	46.15	45.11	44.22	4.99	4.97
S_3	Vermicompost @5 t ha^{-1}	49.43	49.40	48.03	48.03	6.16	6.12
	S.E. ±	1.18	1.16	1.05	1.19	0.14	0.14
	CD at 5 %	2.44	2.39	3.08	3.11	0.42	0.41
D.	**Interaction**						
I.	D × I						
	CD at 5 %	NS	NS	NS	NS	NS	NS
II.	I × S						
	CD at 5 %	NS	NS	NS	NS	NS	NS
III.	S × D						
	CD at 5 %	NS	NS	NS	NS	NS	NS
IV	D x I x S						
	CD at 5 %	NS	NS	NS	NS	NS	NS

CONCLUSIONS

From the above results, it can be concluded that irrigation applied at 40% DASM (Depletion from Available Soil Moisture) provided optimal conditions for wheat under timely sowing conditions. In addition to this, the application of vermicompost at a rate of 5 t ha^{-1} improved soil fertility by adding more nutrients to the soil, leading to better results compared to the other treatment combinations.

Acknowledgement. No task is complete unless your mates are with you. I heartly thank one and all specially Dr. Sharad Pandey, Dr. Maneesh Bhatt, Dr. D.C. kala, Dileep, Patro and Field assistant Ajay for their constant help, cooperation, encouragement and good company during the course of the investigation. At the last, I record my sincere thanks to all the beloved and respected people who helped me but could not find a separate mention here.

Conflict of Interest. None.

REFERENCES

Agami, R. A., Alamri, S. A., Abd El-Mageed, T. A., Abousekken, M. S. M. and Hashem, M. (2018). Role of exogenous nitrogen supply in alleviating the deficit irrigation stress in wheat plants. *Agricultural Water Management*, *210*, 261-270.

Ali, N., Khan, M. N., Ashraf, M.S., Ijaz, S., Saeed-ur-Rehman, H., Abdullah, M., Ahmad, N., Akram, H. M. and Farooq, M. (2020). Influence of different organic manures and their combinations on productivity and quality of bread wheat. *Journal of Soil Science and Plant Nutrition*, *20*(4), 1949-1960.

Badawy, S. A., Sorour, S. G. and Hamad, S. (2021). Effect of nitrogen and potassium fertilizers on wheat productivity under different soil moisture contents. *Journal of Plant Production*, *12*(8), 949-957.

Cheraghi, Y., Mohyedi, F. A. and Kalhor, M. (2016). Effects of organic and chemical fertilizers on yield components of common wheat (*Triticum aestivum* L.). *Islamic Azad University, Cheraghi IIOABJ*, *7*(8), 82-86.

Jat, H. S., Datta, A., Sharma, P. C., Kumar, V., Yadav, A. K., Choudhary, M., and Yaduvanshi, N. P. S. (2018). Assessing soil properties and nutrient availability under conservation agriculture practices in reclaimed sodic soil in cereal-based systems of North-West India. *Archives of Agronomy and Soil Science, 64*(4), 531-545.

Khan, I., Shah, Z., Ahmad, W., Khan, F. and Sharif, M. (2018). Wheat Yield and Post-Harvest Fertility Status of Calcareous Soil Using Shallow and Deep Tillage and Integrated Nutrient Management (INM). *Sarhad Journal of Agriculture*, *34*(2).

Muhsin, M., Nawaz, M., Khan, I., Chattha, M.B., Khan, S., Aslam, M. T., Iqbal, M. M., Amin, M. Z., Ayub, M. A., Anwar, U. and Hassan, M. U. (2021). Efficacy of seed size to improve field performance of wheat under late sowing conditions. *Pakistan Journal of Agricultural Research*, *34*(1), 247-253.

Nishant, V., Rana, S. V. and Bharti, N. (2020). Integrated nutrient management for sustainable wheat (*Triticum aestivum* L.) production in western Uttar Pradesh. *Journal of Pharmacognosy and Phytochemistry*, *10*(1), 1856-1859.

Poudel, P. B., Jaishi, U. K., Poudel, L. and Poudel, M. R. (2020). Evaluation of Wheat Genotypes under Timely and Late Sowing Conditions. *International Journal of Applied Sciences and Biotechnology*, *8*(2), 161-169.

Rady, M. O., Semida, W. M., Howladar, S. M. and Abd El-Mageed, T. A. (2021). Raised beds modulate physiological responses, yield and water use efficiency of wheat (*Triticum aestivum* L.) under deficit irrigation. *Agricultural Water Management*, *245,* 106629.

Shah, F., Coulter, J. A., Ye, C. and Wu, W. (2020). Yield penalty due to delayed sowing of winter wheat and the mitigatory role of increased seeding rate. *European Journal of Agronomy*, *119,* 126120.

Singh, G., Kumar, S., Sidhu, G. S. and Kaur, R. (2018). Effect of integrated nutrient management on yield of wheat (*Triticum aestivum* L.) under irrigated conditions. *International Journal of Chemical Studies, 6*(2), 904-907.

Yadav, K., Singh, S. and Kumar, V. (2018). Effect of integrated nutrient management on soil fertility and productivity on wheat crops. *Journal of Experimental Agriculture International, 24*(2), 1-9.

How to cite this article: CH V L Kishore, Sharad Pandey, Maneesh Bhatt, Mamta and BKM Patro (2023). Effect of different Dates of Sowing, Irrigation Scheduling and Soil Amendments on Yield Attributes and Yield of Wheat. *Biological Forum – An International Journal*, *15*(9): 1041-1045.